

THIS REPORT HAS BEEN DELIMITED  
AND CLEARED FOR PUBLIC RELEASE  
UNDER DOD DIRECTIVE 5200.20 AND  
NO RESTRICTIONS ARE IMPOSED UPON  
ITS USE AND DISCLOSURE,

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE;  
DISTRIBUTION UNLIMITED,

**UNCLASSIFIED**

**AD 442859**

---

**DEFENSE DOCUMENTATION CENTER**

**FOR**

**SCIENTIFIC AND TECHNICAL INFORMATION**

**CAMERON STATION, ALEXANDRIA, VIRGINIA**



**UNCLASSIFIED**

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

442859

# X-22A PROGRESS REPORT NO.17

APRIL 1964

442859



AD No. \_\_\_\_\_

DDC FILE COPY

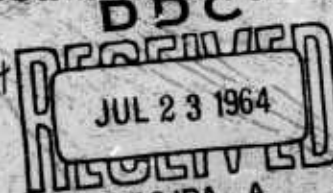
TRI-SERVICE

# V/STOL

RESEARCH AIRCRAFT

REPORT NO. 2127-933017

15 MAY 1964



NAVY CONTRACT NO. N0w 63-0118-ci

6917



**BELL AEROSYSTEMS COMPANY**  
DIVISION OF BELL AEROSPACE CORPORATION - A **SPRINT** COMPANY

# SCIENTIFIC AND TECHNICAL INFORMATION FACILITY

operated for National Aeronautics and Space Administration by Documentation Incorporated

## LOAN DOCUMENT TRANSMITTAL

Please attach a copy of this form to any loan documents sent to the Scientific and Technical Information Facility. A single copy of this form and the document should be sent to the following address:

Scientific and Technical Information Facility  
Attention: NASA Representative  
Box 5700  
Bethesda 14, Maryland

Every effort will be made to return this document in the shortest possible time.

Please complete.

Sent by:

SCIENTIFIC AND TECHNICAL  
INFORMATION FACILITY  
POST OFFICE BOX 5700  
BETHESDA, MD. 20014

Date sent: \_\_\_\_\_

☐

checked for N numbers

☐

checked against N-62 numbers

See other side for NASA contractor report

For Facility Use Only

## LOAN DOCUMENT PROCESSING RECORD

N62- \_\_\_\_\_

Date received: \_\_\_\_\_

X62- \_\_\_\_\_

### THIS DOCUMENT IS ON LOAN

Please process as follows:

☐

Film for Microform and make Xerox copy

\_\_\_\_\_

Initials

\_\_\_\_\_

☐

Microform completed

\_\_\_\_\_

\_\_\_\_\_

☐

Xerox copy made

\_\_\_\_\_

\_\_\_\_\_

☐

Xerox copy sent to Input Station

\_\_\_\_\_

\_\_\_\_\_

☐

Original sent to Mail Room

\_\_\_\_\_

\_\_\_\_\_

☐

Document returned to sender

\_\_\_\_\_

\_\_\_\_\_

THIS LOAN DOCUMENT FORM MUST BE SENT TO THE CASE FILE

6917

COMPLETE FOR NASA CONTRACTOR DOCUMENTS ONLY

DOCUMENT TYPES

1. \_\_\_\_\_ Report is unclassified and is suitable for unlimited announcement and distribution to the aeronautics and space community, and for public sale.
2. \_\_\_\_\_ Report is unclassified, but contains information of limited usefulness and does not justify widespread automatic distribution to the aeronautical and space community. It can, however, be announced and made publicly available.
3. \_\_\_\_\_ Report is unclassified, but for official reasons, must be restricted as follows:
  - a. \_\_\_\_\_ Government agencies and their contractors only.
  - b. \_\_\_\_\_ Government agencies only.
  - c. \_\_\_\_\_ NASA activities only.
4. \_\_\_\_\_ Report bears a security classification and is suitable for distribution within the limits of security considerations to:
  - a. \_\_\_\_\_ Government agencies and their contractors only.
  - b. \_\_\_\_\_ Government agencies only.
  - c. \_\_\_\_\_ NASA activities only.
5. \_\_\_\_\_ Reprint of a journal article reporting NASA-supported work.
6. \_\_\_\_\_ Article prepared for journal publication (preprint or other copy) reporting NASA-supported work. (Normally handled as No. 2 above.)

Estimated date of publication: \_\_\_\_\_

7. \_\_\_\_\_ Material for presentation at a meeting or conference  
Name of Meeting: \_\_\_\_\_ Date: \_\_\_\_\_  
Sponsor(s): \_\_\_\_\_
  - a. \_\_\_\_\_ Scheduled for publication in proceedings. (Normally handled as No. 2 above.)

Estimated date of publication: \_\_\_\_\_

Not scheduled for publication in proceedings and subject to the following limitations or announcement and dissemination:

- b. \_\_\_\_\_ Government agencies and their contractors only.
- c. \_\_\_\_\_ Government agencies only.
- d. \_\_\_\_\_ NASA activities only.

5  
BELL AEROSYSTEMS COMPANY

Buffalo, N.Y.

6 X-22A TRI-SERVICE V/STOL AIRCRAFT.

~~MONTHLY PROGRESS REPORT.~~

14 Report No. 2127-933017

11 April 1964,

9 Monthly progress rept. no. 17, 1-30 Apr 64,

This is the seventeenth Monthly Progress Report as required in Section F(5) of the contract, and outlines progress for the period 1 April 1964 through 30 April 1964.

10  
by *A. J. Marchese*  
A. J. Marchese  
Project Director  
X-22A PROGRAM

WJB

**CONTENTS**

Section		Page
I	INTRODUCTION . . . . .	1
II	SUMMARY . . . . .	3
III	DESIGN . . . . .	7
	A. Flight Technology . . . . .	7
	1. Performance . . . . .	7
	2. Propulsion Analysis . . . . .	7
	3. Stability and Control . . . . .	7
	B. Vehicle Structures . . . . .	8
	1. Criteria and Loads . . . . .	8
	2. Structural Analysis . . . . .	8
	3. Structural Tests . . . . .	9
	4. Aeroelasticity . . . . .	10
	5. Weights . . . . .	10
	C. Design . . . . .	11
	1. General . . . . .	11
	2. Airframe . . . . .	11
	3. Flight Controls and Equipment . . . . .	12
	4. Propulsion . . . . .	12
	5. Electrical and Electronics . . . . .	13
	6. Landing Gear and Hydraulics . . . . .	13
	D. Systems Support . . . . .	13
	1. Human Factors . . . . .	13
	2. Maintainability and AGE . . . . .	14
	3. Environmental Factors . . . . .	14
	E. Systems Analysis and Integration . . . . .	14
	F. Manufacturing . . . . .	14
IV	SUBCONTRACTS . . . . .	28
	1. Propellers . . . . .	28
	2. Variable Stability System . . . . .	28
	3. Transmission System . . . . .	28
	4. Landing Gear . . . . .	29



**CONTENTS (CONT)**

Section	Page
5. Duct Support Tube . . . . .	29
6. Duct Support Plates . . . . .	29
7. Harmonic Drive . . . . .	29
8. Constant Speed Drive . . . . .	29
9. Ejection Seats . . . . .	29
10. Gearboxes . . . . .	30
11. Actuators . . . . .	30
12. Machined Parts . . . . .	30
 V MODELS . . . . .	 31
A. Wind Tunnel Test Program . . . . .	31
1. 1/5 Scale Powered Airplane Model . . . . .	31
2. 1/3 Scale Powered Duct Model . . . . .	31
3. Full-Scale Powered Duct Model . . . . .	31
4. Free Flight Model . . . . .	31
5. 1/20-Scale Spin Model . . . . .	31
6. 1/7 Scale Complete Flutter Model . . . . .	31
 VI GENERAL . . . . .	 32
A. Trips and Visitors . . . . .	32
B. Correspondence and Reports Submitted During the Period of April 1 - April 30, 1964 . . . . .	34
C. Open Items . . . . .	36
D. Distribution List . . . . .	38

ILLUSTRATIONS

Figure		Page
1	X-22A Tri-Service Research V/STOL Aircraft . . . . .	2
2	X-22A Milestone Chart Data Requirements (Second Quarter - 1964) . . . . .	5
3	Program Schedule . . . . .	6
4	Forward Right Duct - Propulsion Test Stand . . . . .	15
5	Forward Right Duct - Propulsion Test Stand . . . . .	16
6	Forward Right Duct Rotated - Propulsion Test Stand . .	17
7	Engine Mounts and Two Gear Boxes - Propulsion Test Stand . . . . .	18
8	Engine Mount and No. 8 Gear Box - Propulsion Test Stand . . . . .	19
9	Propulsion Test Stand Engines . . . . .	20
10	Duct Leading Edge Subassembly . . . . .	21
11	Duct Trailing Edge Subassembly . . . . .	22
12	Aft Section of Main Fuselage . . . . .	23
13	Upper Fuselage Subassembly . . . . .	24
14	Lower Fuselage Subassembly . . . . .	25

## I. INTRODUCTION

Bell Aerosystems Company was awarded Contract NOw 63-0118-ci by the Department of the Navy, Bureau of Naval Weapons for two Model X-22A Tri-Service V/STOL Research Aircraft. The official contract was authorized on 30 November 1962.

The X-22A aircraft is a dual tandem ducted propeller research airplane (Figure 1), with a prime mission of exploring the mechanical and aerodynamic problem of an aircraft designed and constructed for both vertical takeoffs and landings as well as conventional type operation. Lift and thrust are provided by four turboshaft engines mounted in dual engine pods, one on each side of the aft fuselage. Four rotatable ducted propeller units, each including a three-blade propeller, are interconnected and driven by the engines through an aircraft transmission system.

This aircraft, with speeds up to 303 knots, carries a flight crew of two, and is capable of carrying a 1200 pound payload while maintaining continuous hover. . . with one engine out. With four engines in operation the payload range will be substantially increased. Provisions are made for the installation of six passenger seats in the cabin area. The aircraft is in the 15,000 pound gross weight category.

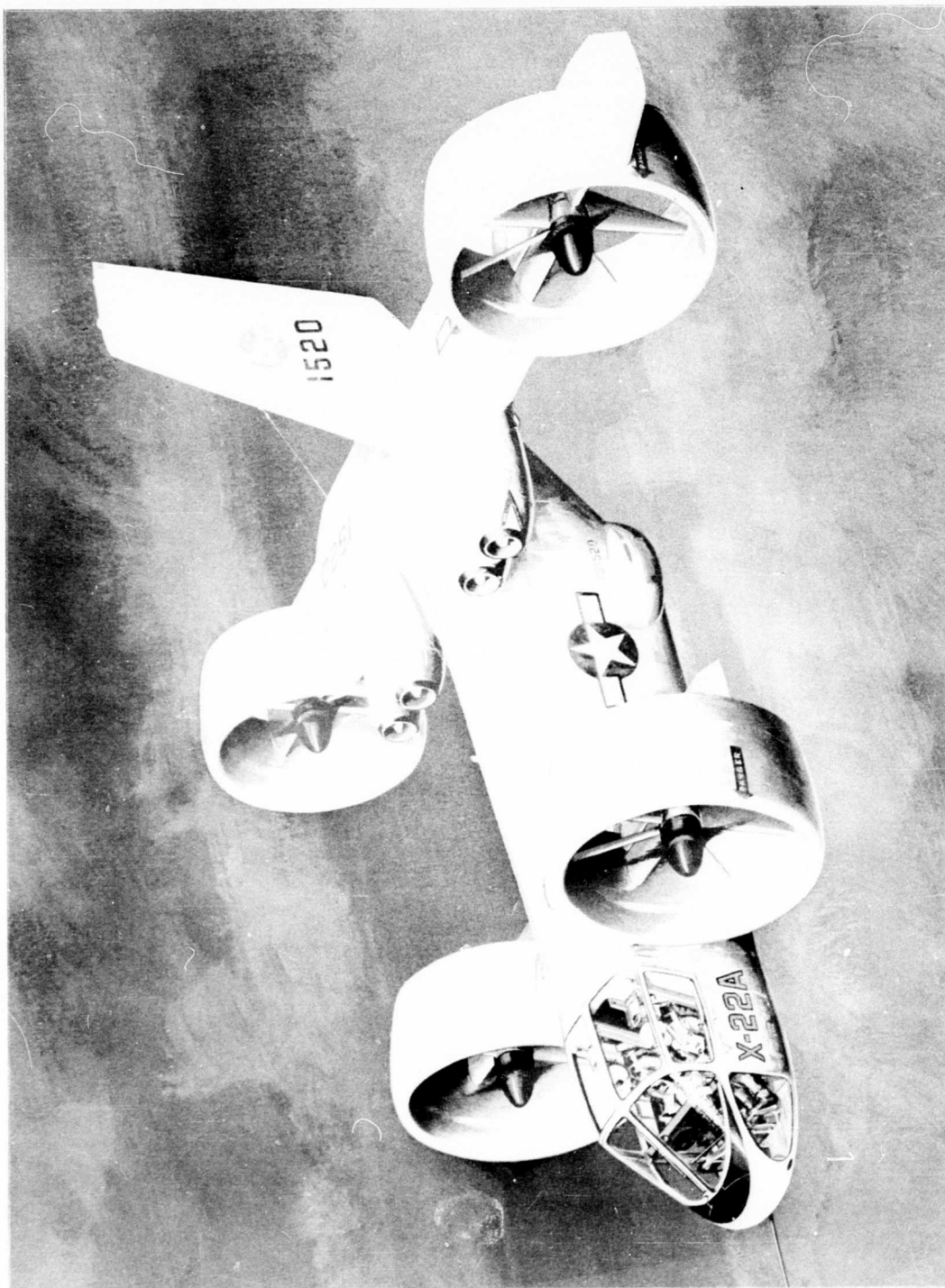


Figure 1. X-22A Tri-Service Research V/STOL Aircraft

## II. SUMMARY

Engineering has continued its release of drawings to Manufacturing for fabrication with a cumulative total of 90.1% of drawings released through this report period. This amounts to 94.5% of Bell fabrication and 87.9% of the Bell controlled X-22A weight.

Aircraft weight remains within target tolerances though it has fluctuated upward due to adjustments resulting from detailed design releases and refined calculations from subcontractors.

The 1/20 scale spin model tests at NASA Langley, started in January, are continuing. The Free Flight Model Tests are scheduled to start in June. Phase II powered airplane 1/5th scale model test report data is being prepared for submittal, as the data which had been retained at NASA for recheck has been received. DTMB has completed the rebuild and calibration of the 1/3 scale powered duct model and tests are to resume in early May. The full scale Duct and Propeller model, delivered in January to the NASA-Ames Tunnel Facility is being assembled and set up outside of the tunnel. The actual testing has been rescheduled to June 1964.

Final acoustic tests on the new test specimen are being set up to finalize the damping material requirements.

Fabrication and setup of both the Propulsion Test Stand and the Flight Control and Hydraulic Test Stand has been completed. Systems are being installed in both. Final setup of the Main Fuselage Assembly, Fin, Stabilizer, and Duct fixtures has been completed in the assembly area. The Stabilizer, Elevon, and Final Wing (second stage) Assembly and other fixtures continue in work.

Coordination was maintained with BuWeps by Bell Management regarding the overall contract status, cost, and funding.

The manufacturing effort continued to peak as the detail fabrication momentum leads into the assembly stages. A buildup of vendor hardware deliveries continued for the initiation of varied fabrication phases.

The coordinated efforts of Project, Engineering, Manufacturing, Quality, and Procurement was greatly utilized to effectively resolve areas of schedule slippage and program restraints due to late GFE and vendor deliveries. With essentially all major schedule problem areas resolved through inhouse scheduling, the 42 months contractual program delivery and V/STOL flight dates have been maintained.

Subcontractor coordination, review meetings, and technical visits, have been maintained. Management controls of PERT scheduling and costing continued.

During the April period, all contractual reports and data requirements were completed essentially as scheduled. The thirteenth PERT Cost Report and PERT Milestone Computer report for the month of February which had been delayed was submitted to BuWeps. The monthly PERT updating as of 24 April 1964 is in work.

Figure 2, the X-22A Milestone Data Requirements Chart for the 2nd quarter of 1964, and Figure 3 Program Schedule, reflect the program and status as of 30 April 1964.

All operating departments are continuing with necessary planning and interdepartmental coordination as required. Daily meetings attended by members of the X-22A Management Organization and Top management program reviews have been held.

DATA REQUIREMENTS (SECOND QUARTER 1964)		APRIL			MAY			JUNE		
		7	14	21	28	7	14	21	28	
SUMMARY OF ENGINEERING DATA CHARACTERISTICS SUMMARY NAVEXOS FORM 4153		▼	▼					▼	▼	
						▼				
MONTHLY PROGRESS REPORT							▼			
PERT MILESTONE COMPUTER REPORT								▼	▼	
PERT COST REPORT								▼	▼	
DD-1140-1 (SMALL BUSINESS REPORT)										▼
INTERIM PERT REPORT										
DD-1177 (CONTRACT COSTS)		▼				▼				
DEFENSE CONTRACTORS PLANNING REPORT (DCPR)										
INVOICES										
WEIGHT AND BALANCE STATUS REPORT										
REVISED PAGES (CONTRACT DETAIL SPEC)										
WEAPON SYSTEM MASTER PLAN (REVISION)										
DEMONSTRATION PLANNING AND PROGRESS REPORT										
SUMMARY TECHNICAL REPORT (MATERIALS)										
STAB AND CONTROL AND FLYING QUALITIES RPT										
SUBMITTAL DATES CONTINGENT UPON OTHER ACTIVITIES										
FLIGHT CONTROL SYSTEM - DESIGN REPORT						▼				
FLIGHT CONTROL SYSTEM - FAILURE ANALYSIS									▼	
CRITICAL AREA TEST REPORTS (DUCT NOISE TESTS)								▼		
PROPULSION SYSTEM ANALYSIS REPORT										
CALCULATED WEIGHT REPORT										
AERODYNAMIC AND FLUTTER MODEL TEST REPORTS (DUE 40 DAYS AFTER RECEIPT OF TEST DATA)										
1/7 SCALE COMPLETE AIRFRAME FINAL REPORT										
1/5 SCALE POWERED MODEL (PHASE II) FINAL REPORT						▼		▼		
SPIN MODEL FINAL REPORT									▼	

▼ = SCHEDULED

▼ = COMPLETED

Figure 2 X-22A Milestone Chart Data Requirements (Second Quarter-1964)

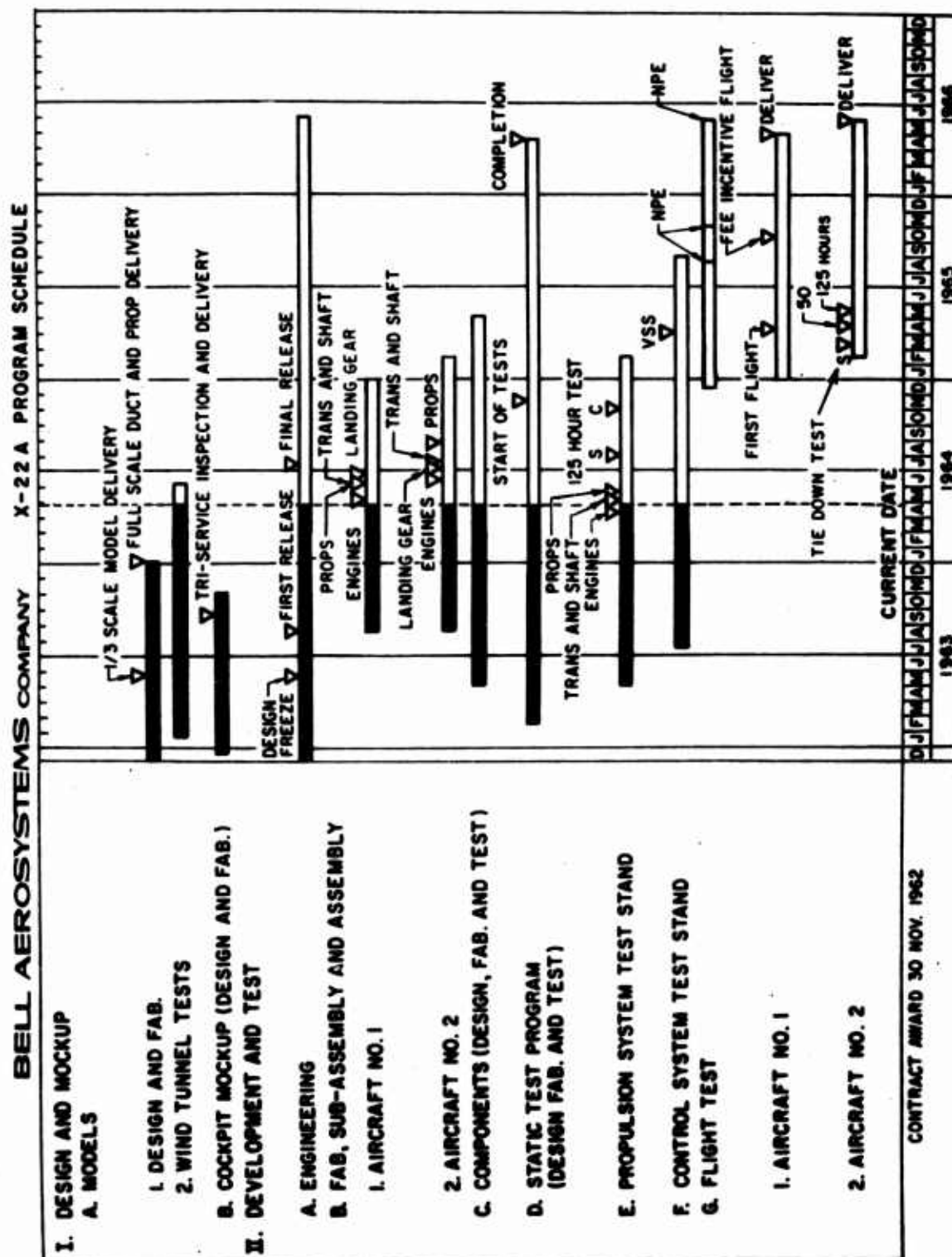


Figure 3. Program Schedule



### III. DESIGN

#### A. FLIGHT TECHNOLOGY

##### 1. Performance

An analysis has been started to determine short landing performance and to recheck short takeoff performance. Landing performance calculations were made for conventional landings with the ducts in the cruise configuration, and short landing performance data are now required for stability and control checks in compliance with applicable MIL specifications.

Results of short takeoff calculations with current propulsion and aerodynamic characteristics indicate that the STO distance over a 50 foot obstacle may be reduced below the 900 feet previously shown by pulling a high angle of attack at lift-off.

##### 2. Propulsion Analysis

The fuel system analysis report draft has been released for internal review.

The pretest report on the full scale duct has been completed and is being reviewed internally.

Several additional load cases were estimated for structures checks.

##### 3. Stability and Control

The fifth revision of the Stability and Control and Flying Qualities has been completed. This issue incorporates the final aerodynamic stability and control data for conventional flight as determined from the Phase II 1/5

scale powered model wind tunnel tests. The longitudinal loads breakdown in transition are also revised in this issue.

All of the data from the Phase II 1/5 scale tests, for both transition and conventional flight, have been evaluated and related to full scale thrust and flight conditions. A complete set of final data is now available from which existing analyses can be updated and new and final analyses made.

## **B. VEHICLE STRUCTURES**

### **1. Criteria and Loads**

The revised version of the flight load criteria report is 90% complete. Design loads have been established for the compound elevon assuming that maximum aileron travel will be  $10^\circ$  at 160 knots and  $20^\circ$  at 80 knots. A computation table has been established for determining control derivatives using elevon and propeller force characteristics as basic input data. This table is now being programmed for the IBM 7090 computer in order to aid in determining control derivatives for rolling pull-out analyses. Stability derivatives have been determined for flight at  $V_{LT}$  for duct angles of  $15^\circ$ ,  $30^\circ$ ,  $45^\circ$ ,  $60^\circ$ , and  $75^\circ$ . These will be employed in the analysis of transition rolling pull-out maneuvers.

### **2. Structural Analysis**

#### **a. Flight Controls**

Considerable effort has been spent evaluating the spring rate of the collective pitch boost actuator system, the pitch boost actuator system and the aft roll/yaw boost actuator system. It now appears that these systems will need stiffening for improved control system response.

Due to an increase in the size of envelope of the aft roll/yaw booster as required by the vendor, a redesign of the booster fitting is underway.

Part No. 2127-542091, a torsion bar shaft in the harmonic drive motor gearbox, has been changed from 18% Maraging steel at 260,000 psi heat treat to Republic HP 9-4-25 steel at 200,000 psi heat treat. This Republic steel alloy has excellent impact strength with a Charpy V-notch value of 60 ft-lb compared to 23 ft-lb for 18% Maraging steel. This change was prompted by a 14 April 1964 communication from Bureau of Naval Weapons.

Installation of the flight control system linkage in the aft fuselage required redesign of Sta. 396 bulkhead and Sta. 402 and 406 frames. Additional stiffening members on Sta. 396 were required to mount the pitch and collective pitch gearboxes. The top right hand side of Sta. 402 and 403 were changed to machined parts to be spliced into the regular sheet metal frames. Machined intercostals between the frames were required at various locations to carry high fore and aft loads up to the skin.

b. Hydraulics

Analysis of new actuator arm on the elevon actuator assembly shows a high stress level on this vendor supplied part. The vendor has been requested to submit an analysis to verify the design.

3. Structural Tests

a. Static Test Program

Planning for the static test program continued. Preliminary rough drafts of the structural tests and description of the test article reports have been completed. Also, a rough draft of the critical areas test report has been completed.

b. Acoustic Fatigue Tests

Results of the damping material environmental humidity and temperature extremes, and vibration tests have been evaluated. The F80 type Aquaplas material possesses the best suited qualities. The humidity tests indicate a surface layer softening or water absorption, thus, a thin polyvinyl chloride (PVC) coating will be applied to prevent erosion, but still allow evaporation drying of the Aquaplas. Good adhesion of the Aquaplas was maintained through all of the environmental and vibration tests.

The fourth duct structure acoustic test specimen is being prepared for additional tests in the acoustic facility.

4. Aeroelasticity

The 12 degree of freedom flutter analyses confirm model test results that flutter speeds are more than 20% higher than limit dive speed. Anti-symmetric mode analyses are currently in work.

Analyses have been initiated to investigate the effects that control system components have on the X-22A flutter speeds. To date, work has been confined to symmetric analyses involving the interaction between the aeroelastic modes of the airframe, stability augmentation system, boost actuator, and the elevon hydraulic actuator. Analyses involving the antisymmetric planes are also being planned. In addition, stability analyses involving the X-22A in hover, and including the airframe elastic modes, SAS pitch rate gyro, the governor, the control system and power transmission system are being planned.

5. Weights

The current weight empty is 347.8 pounds over the target weight. To date, 87.9% of the contractor weight has been released. Weight changes during the past month added 53.8 pounds. The major items causing this increase are:

Hamilton Standard reported a 29 pound increase per airplane in propeller blade weight.

Providing access doors and stiffening for flight controls supports added 12.9 pounds to the wing and body.

Released drawings revealed increases totaling 11.9 pounds.

Four GFAE engines slated for spares were weighed and are approximately 32 pounds per airplane lighter than the specification weight.

The 8th weight and balance status report and the calculated weight report, both due in May, have been started.

The c.g. remains satisfactorily located within limits.

#### C. DESIGN

##### 1. General

Airframe changes to accomodate flight controls, propulsion and the electrical systems are being incorporated. Work is continuing on the flight control system assembly and installation drawings.

Design reviews of the harmonic drives, transmission system, integral gearbox, propeller and the landing gear continued during this period. All interface problems to date have been resolved. Several minor items including schedule delays are in process of being resolved.

Release of assemblies and details of the electrical, propulsion, and hydraulic systems are continuing.

##### 2. Airframe

The airframe has been completely released and present effort on this item consists of revisions to drawings resulting from changes in systems plus subcontractor and shop liaison.

### 3. Flight Controls and Equipment

Final design reviews of all flight control gearboxes have been held with the subcontractor and all problems of major nature have been solved. All details of the flight control system have now been released. The cockpit controls area installation drawing has been completed. The canted bulkhead controls installation drawing has also been released.

Effort in the equipment and furnishings area consists of drawings on the heating and ventilating system, seat installation and the low airspeed indicator. Work has also been started on the ground support equipment.

All details of the flight control system test stand have been released and work continues on the installation of supports and bracketry on which to mount the system components.

### 4. Propulsion

#### a. Transmission

The updated propeller gearbox assembly drawing has been completed. Visits to Speco and Hamilton-Standard Division were made during this report period. Tests at Speco resulted in overheating of the fuselage gearbox. Intensive efforts are being made to correct this problem. Excessive vibration of the aft engine support was experienced on the Hamilton-Standard Division test stand. This difficulty has been corrected.

#### b. Systems

The fuselage gearbox oil system design is now approximately 75% complete.

Drawings of the power controls and the fuel shut-off installations are in process.

c. Propulsion Test Stand

The layout of the fuel system for the test stand is nearing completion, and information for purchase of hardware has been released. Work is progressing on the control room, instrumentation and the fuel supply system.

5. Electrical and Electronics

Work is continuing on the instrument wiring diagram, the aft gyro installation, the electrical assembly for the overhead circuit breaker box, the installation and specification control drawing for the rotation joint cable, the installation of electrical equipment in the center console and advance bill of material for wire, connectors, relays, and miscellaneous equipment.

The warning lights wiring diagram has been completed, and several details and installation drawings have also been completed.

6. Landing Gear and Hydraulics

Visits were made to the landing gear, the servo valves, and actuator subcontractors. No major design problems exist in these areas.

The hydraulic power source and main distribution drawings have been completed.

The forward and aft duct rotation system drawings have been completed.

Both the main and nose gear final installation drawings are in work and nearing completion.

D. SYSTEMS SUPPORT

1. Human Factors

Inspection and final acceptance testing of the cockpit simulator was completed on April 21, 1964. Compilation of test variables and order-of-runs

for the simulation program are being planned and will be coordinated with the Flight Technology and Systems Analysis Sections.

## **2. Maintainability and AGE**

An investigation of the installation problems and sequence of the gear-boxes and shafting has been conducted to determine the requirements and parameters for AGE and for special tools. Design descriptions have been finished for additional pieces of AGE. A list of special tools required for maintenance of the propulsion transmission system has been compiled.

## **3. Environmental Factors**

Noise tests have been planned for the Hamilton-Standard Division propeller test stand and have been reviewed with this vendor. Microphone mounts to be used in this test have been specified, and procedures issued.

## **E. SYSTEMS ANALYSIS AND INTEGRATION**

The Control System Design Report is continuing. Technical discussions were held with the Avionics Division to initiate work on the artificial feel and trim system and to discuss the stability augmentation system amplifier requirements.

The accuracy, linearity, dynamic response, and other functional characteristics of the flight control system were thoroughly reviewed to permit description in the Part II Variable Stability System Specification. This specification was completed, reviewed by Bell, and submitted to BuWeps.

## **F. MANUFACTURING (See Figures 4 through 14)**

During April, over 125 drawings were released to manufacturing with the program total now in excess of 1700. An average of 1600 Shop Travelers



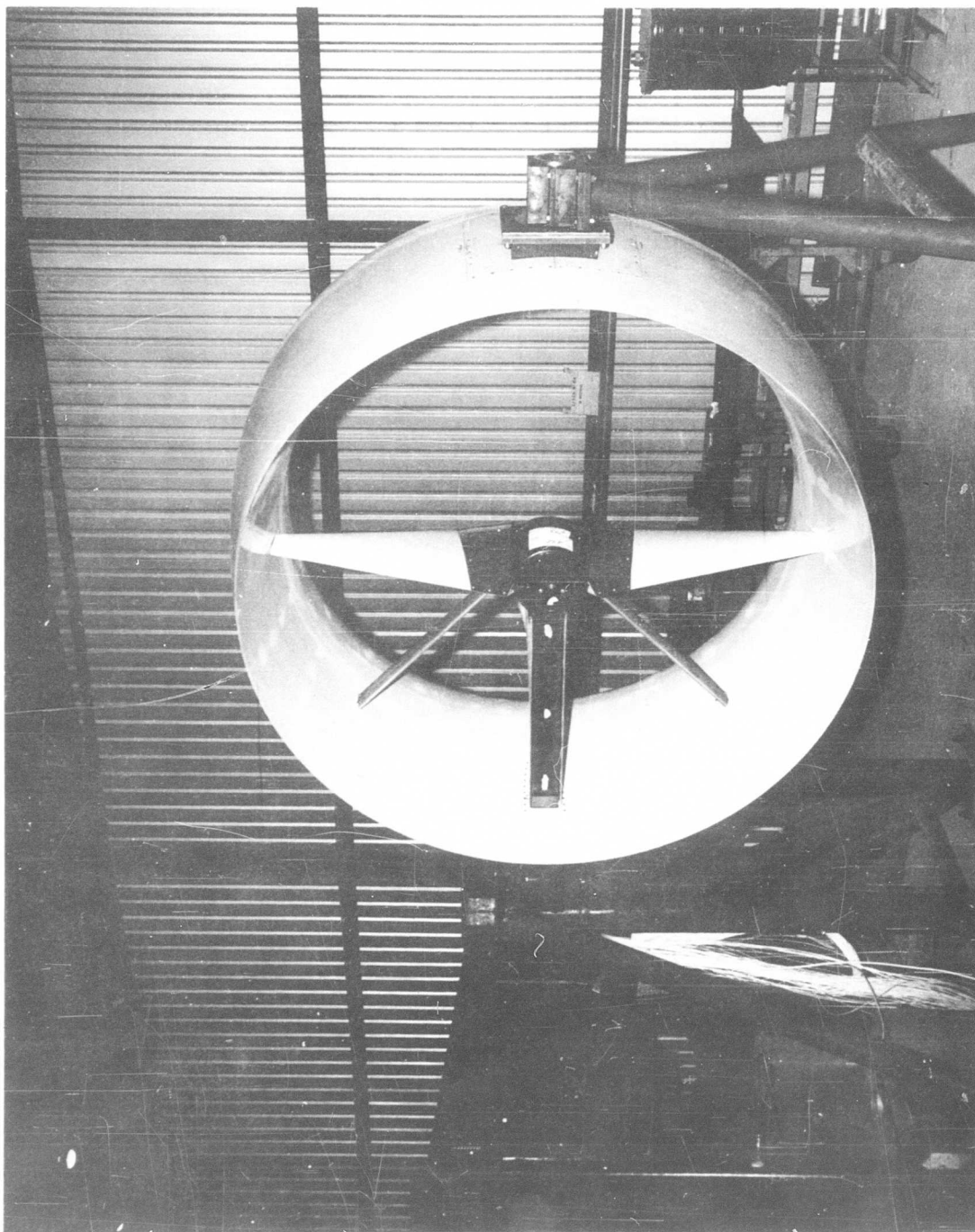


Figure 4. Forward Right Duct - Propulsion Test Stand

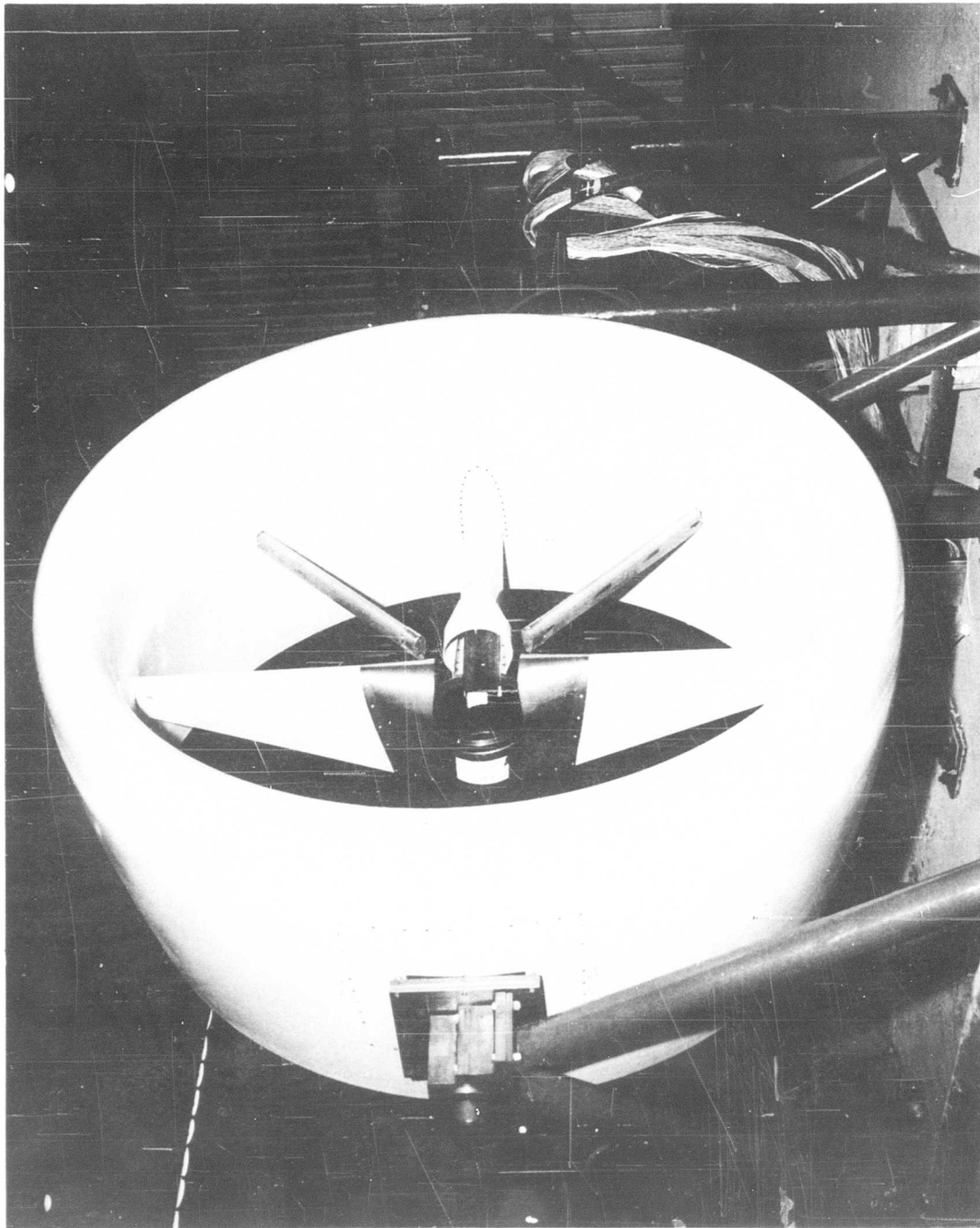


Figure 5. Forward Right Duct - Propulsion Test Stand

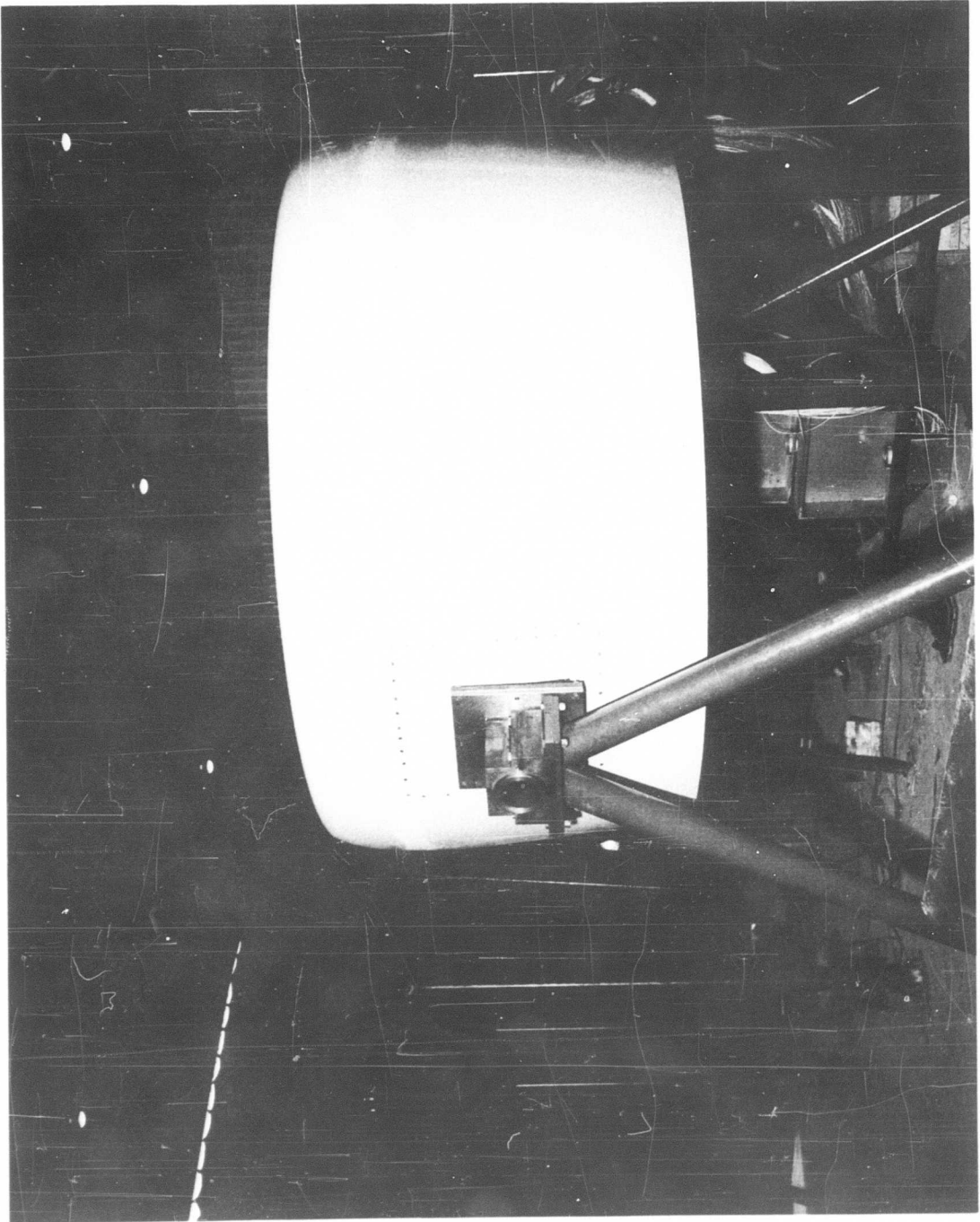


Figure 6. Forward Right Duct Rotated - Propulsion Test Stand

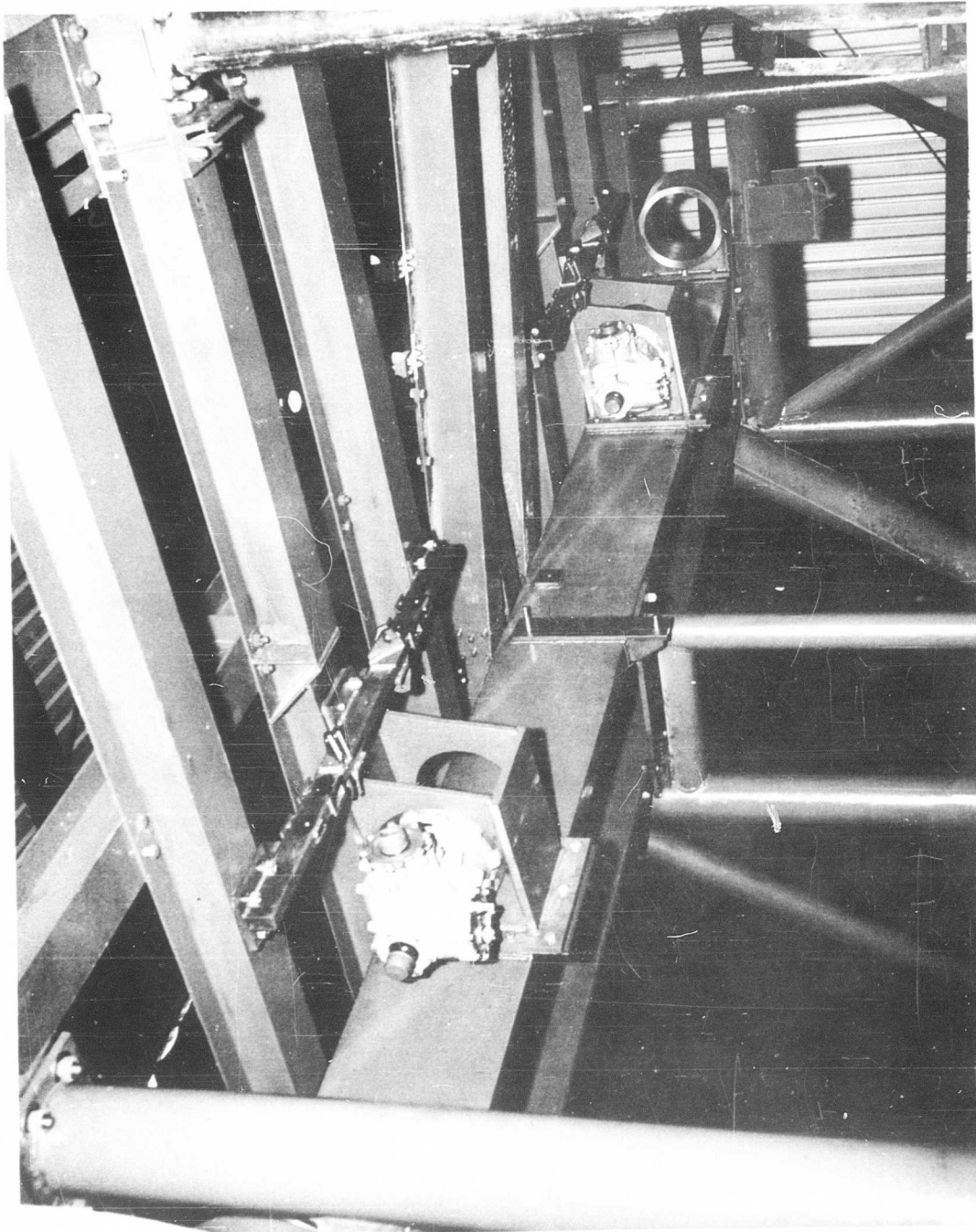


Figure 7. Engine Mounts and Two Gear Boxes - Propulsion Test Stand

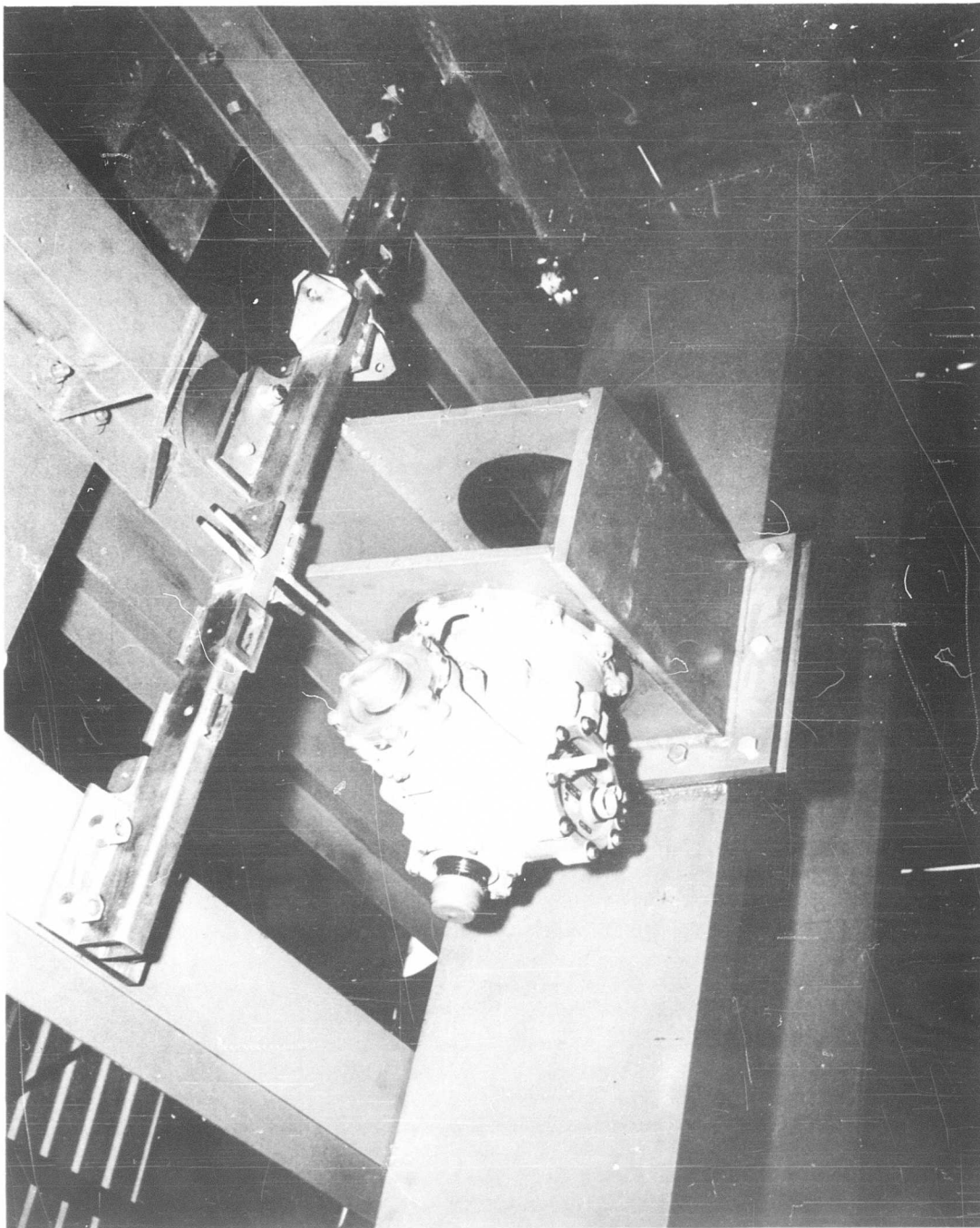


Figure 8. Engine Mount and No. 8 Gear Box - Propulsion Test Stand



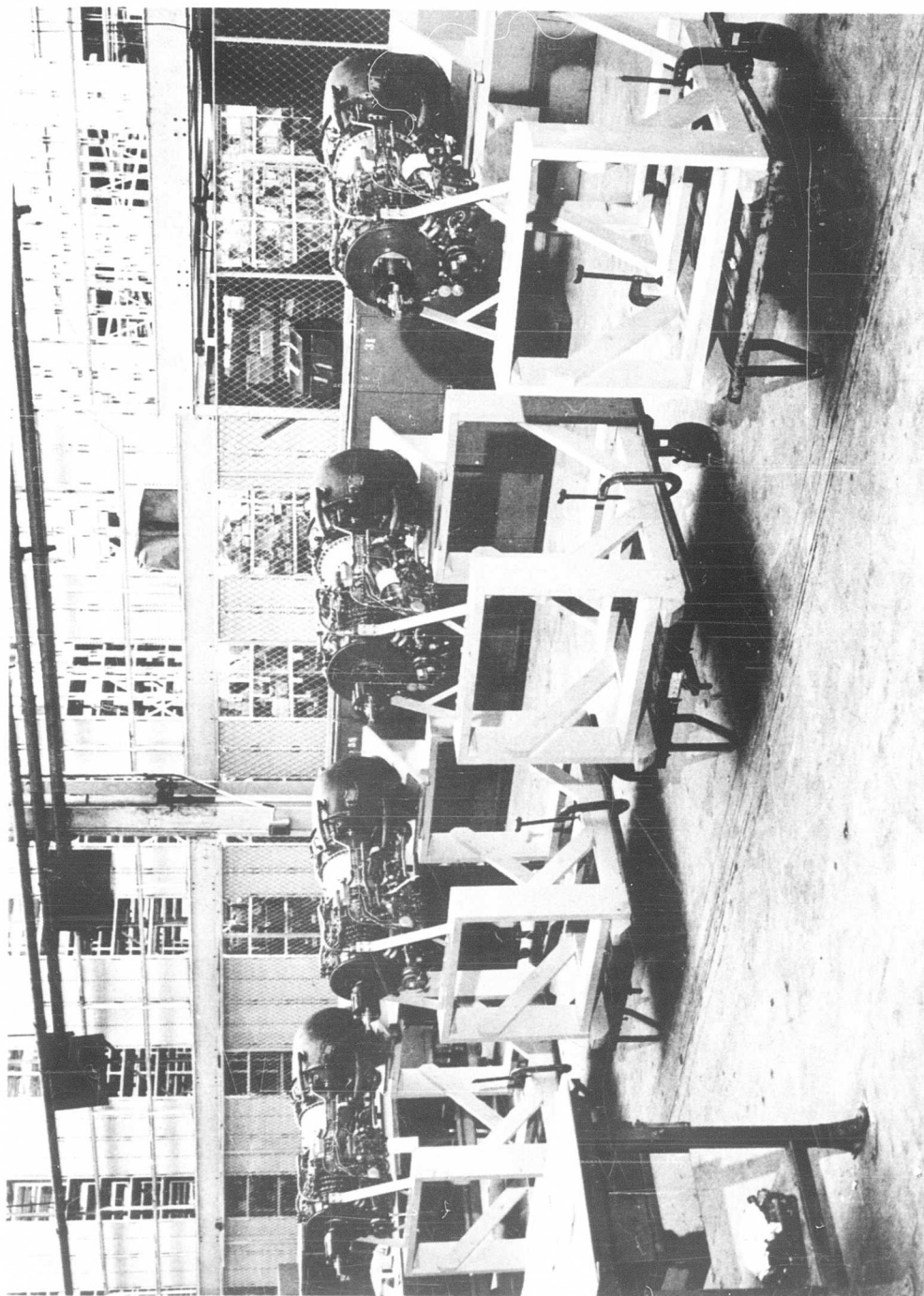


Figure 9. Propulsion Test Stand Engines

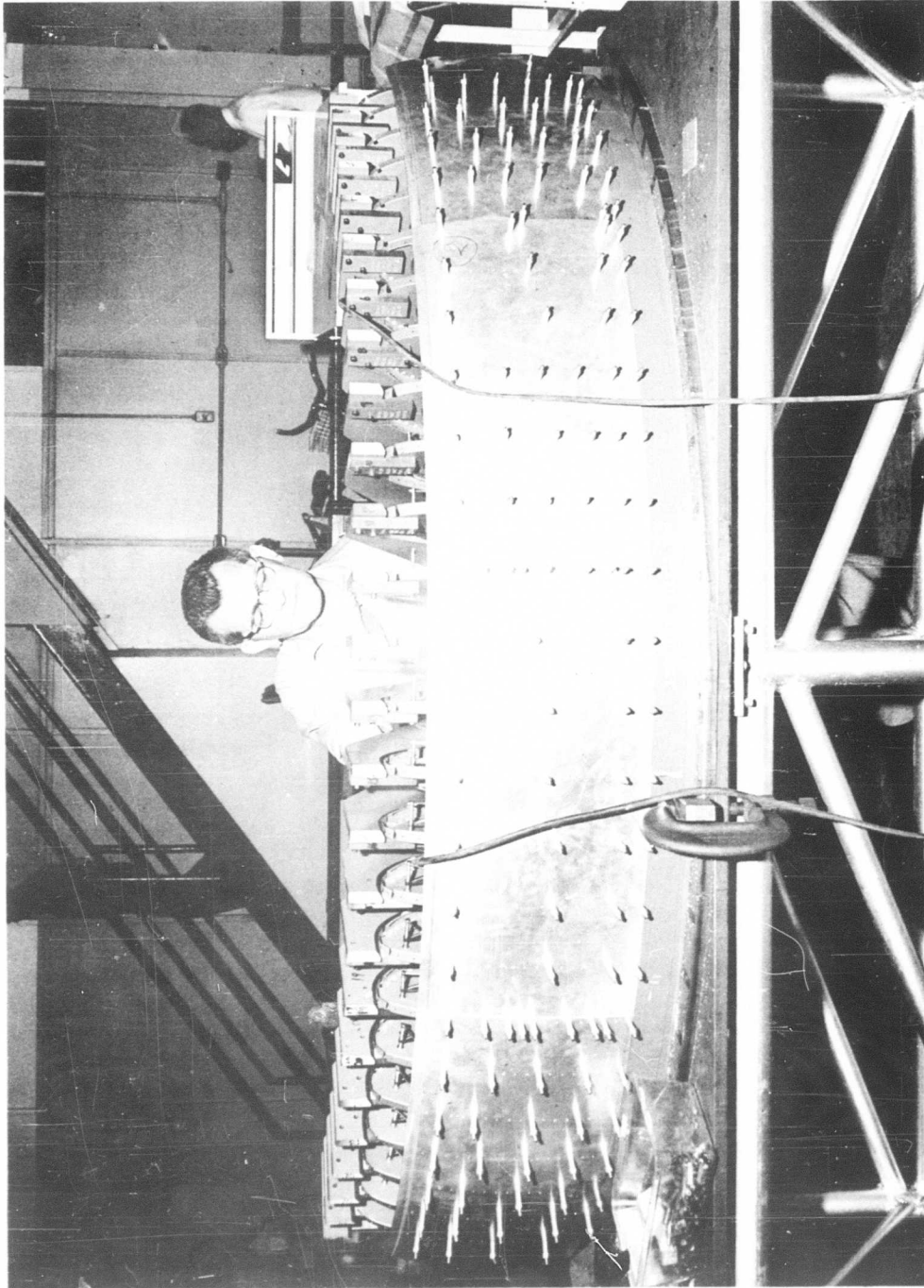


Figure 10. Duct Leading Edge Subassembly

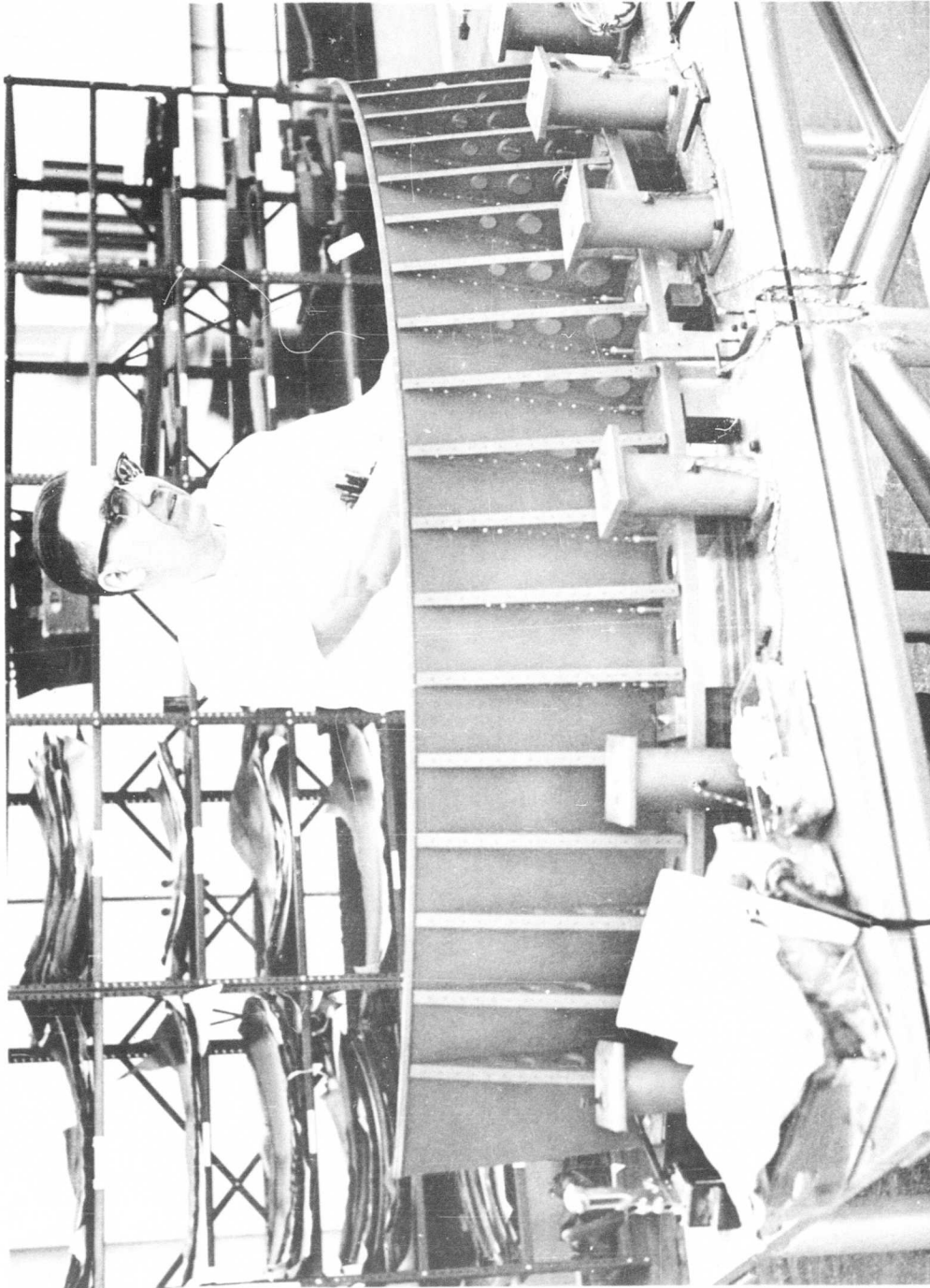


Figure 11. Duct Trailing Edge Subassembly





Figure 12. Aft Section of Main Fuselage

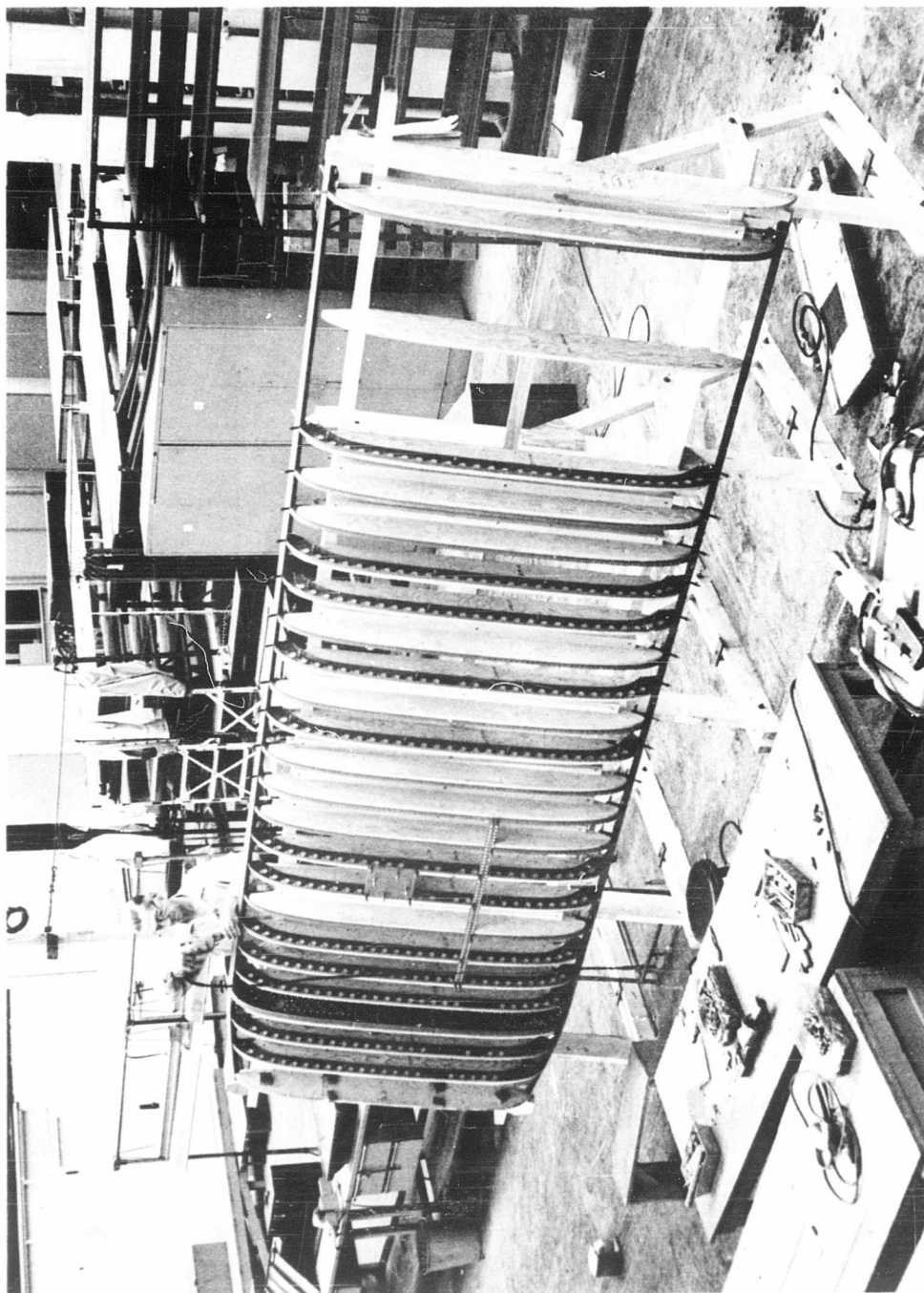


Figure 13. Upper Fuselage Subassembly

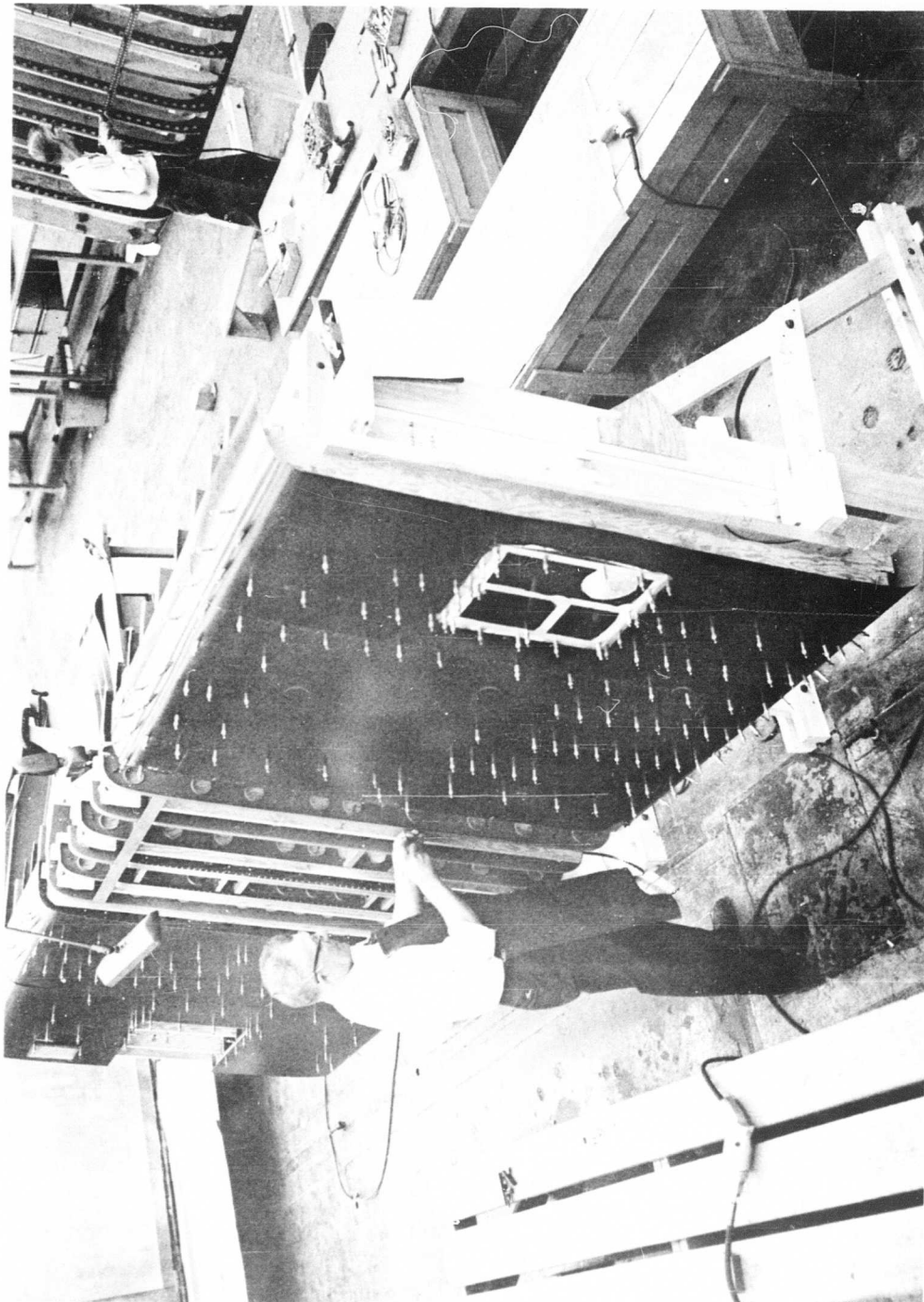


Figure 14. Lower Fuselage Subassembly

continued in process with 1750 completed during the month out of a total of 4600 completed to date. A total of 3680 tool orders have been completed to date, 220 of these during April. With this activity, Manufacturing progressed deeply into detail fabrication, with subassembly operations increased and final assemblies initiated.

Major and subassembly fixtures for the initial program use have been completed and set up in the X-22A assembly area. Work continues for the completion of the stabilizer, elevon, door, strut, wing second stage and the fuselage final assembly fixtures.

The Propulsion System Test Stand and the Flight Control-Hydraulic System Test Stand Structures have been erected. Installation details are being completed and system buildup continues in these test stands.

Three Propulsion Test Stand Ducts have been installed for alignment of other systems components. Two engine gearboxes have been installed and shafting installations started. In the absence of a complete set of gearboxes, mock-ups are being used. The four engines for the propulsion system test stand have been converted to downward exhaust and are now in buildup prior to installation in the stand.

The Flight Control-Hydraulic System Test Stand bearing hangers installation has begun. The duct simulation adapters are due in early May. A complete scheduling of Test Stand hardware is being prepared to expedite systems completion and installations.

Duct Main Assembly fixtures rework has been completed. The first beam segment has been built up in the first leading edge subassembly fixture for static test use. Additional segments have been completed, ready for polishing prior to buildup in the leading edge fixture. Two trailing edge assemblies are in work and the beam-to-beam ribs are in subassembly.



The basic wing assembly fixture has been completed. Capstrips for the front beam assembly are in the shop. Other materials and details are due for assembly during the next month.

Fuselage assembly has started but is dependent on completion of the upper and lower fuselage, canopy, cockpit and duct rotation box beam subassemblies, all of which are in work.

Material shortages and other schedule problems are being investigated for prompt resolution and required coordination to minimize any program restraints. Shortage, delay, and schedule sheets maintained in the manufacturing X-22A control center area provide for immediate problem recognition and action.

#### IV. SUBCONTRACTS

1. Propellers - Hamilton Standard Division of United Aircraft Corporation.

The monthly Program Review Meeting was held at Hamilton Standard on April 23rd.

The 50-hour back-to-back tests have been completed. 89 hours have been accumulated on the Whirl Tests.

Engine Rig - 38 hours have been accumulated. A temporary rig bearing failure occurred, which will be corrected and testing resumed on May 6th.

2. Variable Stability System - Cornell Aeronautical Laboratories

The second section of the Specification was completed and furnished to Bell.

A Cost Review and Re-estimate to Completion were made and reviewed by Bell.

Electrical detail design approximately 80% complete; mechanical design of the fin installation is 90% complete.

Procurement of shared instrumentation continues, and is almost completed.

Fabrication of the first VSS Equipment Rack was begun.

3. Transmission System - Steel Products Engineering Company

Engine Gearboxes for the Test Stand have been received at Bell, plus a mockup Fuselage Box. An oil cooling problem developed in the fuselage box undergoing tests, and a solution to this problem is under investigation and trial.

SPECO is having delivery problems with their interconnecting shafting Vendor. Visits have been made by SPECO personnel to Subcontractor to expedite.

4. Landing Gear - Loud Company (new company name)

All parts currently in work, with delivery rescheduled to June 14th.

Bell Engineering and Procurement Representatives were at Loud during the month to review status of the program.

Delivery of wheels and brakes from Goodyear are now scheduled for June 1st.

5. Duct Support Tube - Cleveland Pneumatic Tool Company

Vendor has been machining the support tube, and the first un-splined unit has indicated a slippage of three weeks due to machineability learning problems on maraging steel.

Visits made to Vendor by Bell Procurement and Manufacturing personnel.

Bell attempting to work around the late delivery of the first tube.

6. Duct Support Plates - Engineering Enterprises

Vendor, assisted by Bell, has solved the problem of stabilizing the material. Delivery of the first inboard and outboard sections were held up pending this distortion resolution and delivery is now scheduled in mid May.

7. Harmonic Drive - United Shoe Machinery Corporation

Engineering has been completed. All parts were put in work or ordered. Problem of late procurement of bearing material by Kaydon Bearing Company will delay delivery of the first unit until approximately June 22nd. Schedule problems are being studied at Bell.

8. Constant Speed Drive - Sundstrand Aviation Division, Sundstrand Corp.

The first unit successfully passed tests, and has been delivered to Bell; the next unit is scheduled for delivery in July.

9. Ejection Seats - Douglas Aircraft Corporation

Four aircraft seats are still scheduled for 1 October 1964 delivery. Ejection test seats are targeted for delivery to Bell 15 June.

10. Gearboxes - Western Gear Corporation

Duct Rotation - The gearboxes are currently in work and there are no known problems at this time.

Variable Ratio - Units are in work and there are no anticipated problems.

Beta Control - Bell Engineering spent considerable time at Western Gear assisting in redesign and resolving problems. Delivery now scheduled for July 25th, which is nine (9) weeks late. This situation is being studied to minimize the schedule effect.

11. Actuators - Ronson, Conair and HR&M

Orders have been placed for required actuators. Some actuators indicate delivery of six weeks negative. Efforts continuing to try to improve this condition.

12. Machined Parts - Miscellaneous Vendors

All orders have been placed, and delivery scheduled. In most cases of late delivery in house scheduling adjustments have been made. In remaining critical areas every effort is being made to improve the delivery.



## V. MODELS

### A. WIND TUNNEL TEST PROGRAM

#### 1. 1/5-Scale Powered Airplane Model

Final data have been received from NASA-Langley and the data report is scheduled for submittal 15 May 1964.

#### 2. 1/3-Scale Powered Duct Model

The model rebuilding and calibration has been completed. Tests are scheduled to start 11 May 1964.

#### 3. Full-Scale Powered Duct Model

The model is in stages of final assembly and mounting outside the wind tunnel. Static run-up without the propeller is scheduled for 5 May and with the propeller on 6 May 1964. Following the static run-up, the model will be calibrated. Testing is expected to start early in June 1964.

#### 4. Free Flight Model

Testing of this model is still scheduled to start 15 June 1964.

#### 5. 1/20-Scale Spin Model

Testing of this model is continuing. The model is currently being tested inverted. Following this the c.g. will be moved to the most aft position for further tests. Tests to date have all been with the most forward c.g.

#### 6. 1/7-Scale Complete Flutter Model

Analysis of the test results is continuing. The report submittal to BuWeps is scheduled for 15 May 1964.

## VI. GENERAL

## A. TRIPS AND VISITORS

## 1. Trips

<u>Date</u>	<u>Destination</u>	<u>Purpose</u>
4/1,28/64	Ronson Hydraulics	Actuators
4/2/64	BuWeps	Program Status
4/2,28/64	Conair Inc.	Actuators
4/9,17,24, 28/64	Loud Co.	Landing Gear Status
4/11,18,25/ 64	Kanarr Corporation	Machine Parts Status
4/13,20, 27/64	Kamis Engineering	Machine Parts Status
4/14/64	Cleveland Pneumatic	Duct Support Tubes
4/14/64	Western Gear Co.	Gearboxes
4/14/64	Steel Products Engineer- ing Company	Gear Box Tests
4/17/64	Hamilton Standard	Propeller Gear Box Tests
4/20/64	Steel Products Engineer- ing Company	Transmission System Design Review
4/20/64	BuWeps	Program Status
4/21/64	David Taylor Model Basin	1/3-Scale Model Plans
4/22,23/ 64	Hamilton Standard	Propeller System Technical and Program Review
4/23/64	Goodyear Aircraft	Wheels and Brakes

<u>Date</u>	<u>Destination</u>	<u>Purpose</u>
4/27/64	Steel Products Engineering Company	Gear Box Tests
4/30/64	Hamilton Standard	Cost and Status Review

## 2. Visitors

<u>Date</u>	<u>Company</u>	<u>Purpose</u>
4/2/64	U. S. Rubber	Fuel Tank
4/7/64	Control Products	Pressure Switches
4/8/64	Western Gear Co.	Gear Boxes
4/9/64	Goodyear Aircraft	Wheels and Brakes
4/10/64	United Shoe Machinery Co.	Harmonic Drives
4/13/64	Revere Corporation	Float Switches
4/14/64	Walter Kidde Co.	Fire Extinguishers
4/15/64	U. S. Naval Air Test Center, Pt. Washington	Program Briefing
4/16/64	TRECOM	Program Briefing
4/17/64	Cornell Aeronautical Laboratories	Variable Stability
4/21/64	Western Gear Co.	Gearboxes
4/22/64	Cornell Aeronautical Laboratories	Variable Stability
4/23/64	USAF & NASA	Program Briefing
4/27/64	Russell Associates	Flex Couplings
4/27/64	Controlex Corp.	Control Cables

**B. CORRESPONDENCE AND REPORTS SUBMITTED DURING THE PERIOD  
OF APRIL 1 - APRIL 30, 1964**

<u>Letter No.</u>	<u>Date Submitted</u>	<u>To</u>	<u>Subject</u>	<u>Reason</u>
587	4/1/64	Naval Training Device Center	Visit to BAC	Action
588	4/6/64	BuWeps RA-443	Flight Control System - Pitch Control	Approval
589	4/1/64	BuWeps - RA-443	Materials Approval - Titanium	Approval
590	4/2/64	BuWeps - RA-443	Characteristics Summary	Info.
591	4/6/64	AFCMO	Shortage Form DD-611	Info.
592	Deferred			
593	4/6/64	BuWeps - PID- 25	Defense Contractors Planning Reports	Action
594	4/6/64	AFCMO	Request to ship Govern- ment Property - (Parachute)	Action
595	4/10/64	BuWeps - NPAF- 35	Revision to SD-550-1 (Starter Installation)	Approval
596	4/7/64	BuWeps - RA- 443	GFE Requirements (correction)	Info.
597	4/10/64	BuWeps - RA- 443	Shortage Form DD 611	Info.
598	Deferred			
599	Deferred			
TWX	4/8/64	BuWeps RAAE- 2313	Seat Adjustment Devia- tion	Approval
600	4/9/64	BuWeps RA-443	Ejection Seat Layout	Info.
TWX	4/13/64	BuWeps RA-443	Engine Slippage	Info.
TWX	4/17/64	BuWeps RA-443	Government Furnished Wind Tunnel Test Data	Info.

<u>Letter No.</u>	<u>Date Submitted</u>	<u>To</u>	<u>Subject</u>	<u>Reason</u>
601	4/9/64	BuWeps RA-443	Tri-Service Review	Info.
602	Deferred			
603	4/20/64	BuWeps NPAF-35	Revision to SD-550-1 (Hydraulic System)	Approval
604	Deferred			
605	Deferred			
606	4/17/64	Bethpage NWR IN-CII	Receipt of GFE Engines	Info.
607	4/17/64	BuWeps RA-443	GFE Shortage	Info.
608	4/21/64	BuWeps NPAF-35	PERT Cost Report	Info.
609	4/21/64	NAEC	Ejection Seat Sled Test	Action
610	4/22/64	BuWeps RA-443	Process Specification - Adhesive Bonded and Sandwich Construction	Approval
611	4/23/64	BuWeps RA-443	Weapon System Master Plan - Monthly Status	Info.
612	4/23/64	BuWeps RA-443	Monthly Progress Report No. 16 (933016)	Info.
TWX	4/24/64	BuWeps RA-443	Government Furnished Equipment	Info.
613	4/24/64	BuWeps RA-443	GFE Shortages	Info.
614	Deferred			
615	4/24/64	BuWeps RA-443	Government Furnished Equipment	Info.
616	4/27/64	NASA- Langley	Aerodynamic Stability and Control and Flying Qualities Report	Info.
617	4/27/64	NASA - 7 x 10' Wind Tunnel	Ground Effect Model Final Rpt.	Info.

<u>Letter No.</u>	<u>Date Submitted</u>	<u>To</u>	<u>Subject</u>	<u>Reason</u>
618	Deferred			
619	Deferred			
620	Deferred			
621	4/29/64	BuWeps RA-443	VSS Specification (Part II)	Approval

C. OPEN ITEMS (Submitted at least 30 days prior to April 30, 1964)

1. BuWeps and BuWeps Representative

<u>BAC Letter No.</u>	<u>Subject</u>	<u>Date Submitted</u>	<u>Required Approval Date</u>
28	Basic Aerodynamic Data Report - Revision (2127-917002)	1/24/63	*
31	Human Factors Data Report (2127-919001)	1/29/63	*
122	Revised Pages - SD-550-1 (R-1)	3/29/63	*
174	Revision to Addendum No. 162 (Test Program)	5/1/63	*
179	Performance Data (revision)	5/3/63	*
257	Revision to SD-550-1 (Propeller Brake System)	5/31/63	*
299	Revision to SD-550-1 (Ground Clearances)	6/13/63	*
316	Revision to SD-550-1 (Elevon Balancing)	6/27/63	*
318	Weapon System Master Plan - Revision No. 1	6/28/63	*
326	Revision to SD-550-1 (Fuel Tank Capacity)	7/23/63	*

\*BAC has scheduled a 30 day interval for approval by BuWeps of each of these submittals after BuWeps Representative endorsement.

<u>BAC Letter No.</u>	<u>Subject</u>	<u>Submitted</u>	<u>Required Approval Date</u>
334	Revision to SD-550-1 (Longitudinal Stability and Control Requirements)	7/16/63	*
344	Revision to SD-550-1 (Fuel System Description)	7/23/63	*
356	Human Factors Data - Interim Report	7/31/63	*
375	Revision to Addendum No. 162 (Rev. to Engineering Data)	8/23/63	*
382	Revision to Addendum No. 162 (Drawing Submittal)	8/28/63	*
425	SD-550-1, Addendum No. 162	10/14/63	*
436	Revision to SD-550-1 (Fuel Jettisoning)	11/5/63	*
446	Weapon System Master Plan (Revision No. 2)	11/1/63	*
458	Revision to SD-550-1 (Generator Drives)	11/18/63	*
466	Proposed Revision to Addendum No. 162 (Static Test Requirements)	11/19/63	*
469	Increase in Scope Work	11/22/63	*
479	Materials Approval-Magnesium	12/9/63	*
480	Ground Loads Criteria Report	12/10/63	*
483	Aerodynamic Stability and Control and Flying Qualities Report	12/13/63	*
489	Revision to SD-550-1 (Troop Seats)	12/30/63	*
499	Weapon System Master Plan (Quarterly Revision)	1/2/64	*
500	Materials Approval - Titanium	1/3/64	*

\*BAC has scheduled a 30 day interval for approval by BuWeps of each of these submittals after BuWeps Representatives endorsement.



BAC Letter No.	Subject	Submitted	Required Approval Date
501	Materials Approval - Magnesium	1/6/64	*
503	Revision to SD-550-1 (Shock Absorbers)	1/7/64	*
508	Fire Detection System Specification	1/20/64	*
513	Demonstration Planning and Progress Report	1/22/64	*
514	Demonstration Instrumentation Report	1/22/64	*
516	Revision to SD-550-1 and Addendum No. 162 (Landing Gear Strength)	2/3/64	*
519	Weight and Balance Data Handbook	1/30/64	*
520	Escape System	1/30/64	*
522	Summary of Engineering Data	1/31/64	*
526	Revision to SD-550-1 (Precipitation Static Control)	2/4/64	*
534	Revision to SD-550-1 (Defueling Provision)	2/18/64	*
577	Demonstration Planning and Progress Report (Revision)	3/25/64	*
581	Weapon System Master Plan (Quarterly Revision)	3/30/64	*
582	Landing Gear Drawing	3/30/64	*

\*BAC has scheduled a 30 day interval for approval by BuWeps of each of these submittals after BuWeps Representatives endorsement.

#### D. DISTRIBUTION LIST

The Monthly Progress Report is being distributed to the following:

##### AIR FORCE

Headquarters  
United States Air Force  
Department of the Air Force  
Washington 25, D. C.  
Attn: AFRAE-C-1 copy

##### NAVY

Chief, Bureau of Navy Weapons  
Department of the Navy  
Washington 24, D. C.  
Attn: RA-443-5 copies

**AIR FORCE**

Headquarters  
Air Force Systems Command  
Andrews Air Force Base,  
Maryland  
Attn: SCSAS - 1 copy

Aeronautical Systems Division  
Wright-Patterson Air Force Base  
Ohio  
Attn: ASZTV - 8 copies

**ARMY**

Office, Chief of Research and  
Development  
Department of the Army  
Washington 25, D. C.  
Attn: Air Mobility Division - 1 copy

**NAVY**

Commander, Naval Air Test Center  
U.S. Naval Air Station  
Patuxent River, Maryland  
Attn: Flight Test Division - 2 copies

Mr. C. Weisman  
Office of the Chief of Naval Operations  
Room 5E609  
Washington 25, D. C.  
Attn: OPNAV - 1 copy

Commander W. L. Bennett  
Office of Chief of Naval Operations  
Washington 25, D. C.  
Attn: OP-722-1 copy

Bureau of Naval Weapons Representa-  
tive  
Bell Aerosystems Company  
P. O. Box 1  
Buffalo, N. Y. 14240 - 3 copies

**NASA**

National Aeronautics and Space Admin.  
U.S. Naval Air Station  
Moffett Field, California - 1 copy  
National Aeronautics and Space Admin.  
U. S. Air Force Base  
Langley Field, Va. - 1 copy

**ARMY**

Commanding General  
U. S. Army Materiel Command  
Attn: AMCRD-DM-A  
Building T-7  
Department of the Army  
Washington 25, D. C. - 2 copies

Commanding General  
U.S. Army Mobility Command  
Attn: AMSMO-RR  
Centerline, Michigan - 1 copy

Commanding General  
U.S. Army Test and Evaluation Command  
Aberdeen Proving Ground, Md.  
Attn: Lt. Col. French - 3 copies

Commanding Officer  
U.S. Army Transport Research Command  
Transportation Corps  
Ft. Eustis, Va.  
Attn: SMOFE - AAE - 2 copies

**UNCLASSIFIED**

**UNCLASSIFIED**